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SCIENCE AND TECHNOLOGY

No. 27

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ENERGY

FUTURE ROLE OF COMBINED HEAT AND POWER STUDIED

Frankfurt/Main FERNWAERME INTERNATIONAL in English Apr 80 pp 90-94

[Text]

Historically district heating has not been found to be economic in the UK although industrial applications of combined heat and power (CHP) are common. The energy situation following 1973 caused the UK Government to re-examine a number of possibilities for supply and conservation of energy. The ›Marshall‹ Combined Heat and Power Group was therefore set up to examine the future role for district heating and industrial applications of CHP. Its final report published in 1979 concluded that district heating using power station reject heat was not generally competitive with natural gas heating in the short term. It was however expected to become economically attractive with rising fuel prices in the medium and long term and the Group therefore recommended that a start should be made on one or more ›lead-city‹ schemes. The report also recommended that further development of industrial CHP should be encouraged. The reports recommendations are now being considered by the UK Government.

Concern over the need for energy conservation and the quantities of energy rejected in electricity generation and industrial heat raising led the Secretary of State for Energy to set up the combined Heat and Power Group to assess the potential future role for CHP and to make recommendations. The Group was set up under the chairmanship of Dr. *Walter Marshall* and included representatives from industry, the CBI, the nationalised energy industries, engineering consultants, the universities and government. Their final report has been submitted to the Secretary of State and it has just been published as Department of Energy Paper No. 35 together with all of the supporting reports which are listed in the inset.

The Group devoted most of their efforts to the application of CHP to district heating and industrial needs but also examined briefly the ›biological‹ uses of waste heat and waste incineration.

Godfrey Bevan, who was joint secretary of the Group and works in the Energy Technology Division at the Department, summarises the Group's findings and the thinking behind their recommendations with particular emphasis on industrial applications.

Source of material: Energy Management, issue August 1979.

The material is used with the permission of the Controller of Her Britannic Majesty's Stationery Office.

CHP Group Recommendations

The Group pointed to the energy savings and potential economies achievable by utilising the heat rejected in electricity generation and encouraged positive steps forward with the following reccommendations.

District Heating

- One or more lead city district heating/CHP schemes should be started as soon as practicable with a reasonable measure of financial aid from government if necessary.

- A National Heat Board should be established to initiate a national strategy on district heating/CHP with local organisations being set up to be responsible for individual schemes.

These recommendations were not unanimous with three members preferring the Electricity Supply Industry (ESI) as the lead organisation and one member wanting only a limited commitment to further studies.

Industrial CHP

- The Government should encourage the setting up of worthwhile industrial CHP schemes for single plants and industrial estates for both private and ESI ownership. This could be aided by:

- the setting up of information and advice services which should also seek to estimate the potential for future development
- giving CHP high priority if any further financial assistance is allocated for energy conservation measures.

- The ESI should continue to seek out and give advice and encouragement to worthwhile CHP schemes. This policy should be aided by:
- the ESI being sensitive to the need to encourage CHP in its negotiations on the purchase of electricity from industry.
- the continued publication of its policy on private generation.

- The British Gas Corporation (BGC) should be sensitive to the need to encourage worthwhile schemes in its negotiations for the sale of gas to gas turbine CHP plants.

District Heating

There are a large number of group heating schemes in the UK but very few larger district heating schemes such as the one at Nottingham and only one or two CHP schemes such as those at Aldershot and Pimlico. The Group were therefore faced with the task of a general study of the applicability of district heating/CHP to the UK.

The work started with the setting up of a working party under the chairmanship of Dr. *John Wright* (CEGB). This working party considered

- the extent of development of district heating on the continent and the reasons for its growth there.
- the economics and energy savings of district heating/CHP by examining three sizes of scheme (20, 200 and 2000 MW (th)) for the medium term, and also the longer term situation when oil and natural gas were assumed to be no longer available for heating.

Potential long term economic and energy saving advantages were accompanied by a marginal position in the medium term which was also complicated by issues such as freedom of choice of fuels and disturbance while laying heat mains under streets. Advice was therefore sought by means of publishing the working party's report (Energy Paper 20) in 1977 to encourage discussion.

The resulting formal and informal discussion with individuals, industry and institutions was of enormous value to the Group in concluding the studies in many areas and that discussion is summarised in the report. A consequent study was set up under the chairmanship of Professor *Jim Cassels* (Liverpool University) to estimate the national potential heat load of high enough density to be economically coupled to district heating networks.

This was done by surveying representative towns and then interpolating values for other cities on the basis of population.

The study showed that the potential heat load amounted to 45 GW at over 15 MW/km² falling to 32 GW at 20 MW/km². Over half of this heat load was associated with Greater London and about 80 % comes from the five largest conurbations.

The results of the Group are based on three key assumptions. First, that the district heating network supplies hot water in the region of 100 °C. Secondly, that fuel prices double in real terms by the turn of the century. Thirdly, that discount rates in the range 5–10 % are used. When compared, in national resource terms, with other available options such as gas (SNG in the longer term), heat pumps and direct electric heating, the findings were:

- in the medium term district heating in inner-cities and large cities was an attractive economic option when coupled to large/medium sized CHP turbines.
- large CHP plant would be more economic and give greater energy saving than small plant.
- in the longer term when oil and natural gas were no longer available CHP looked the most attractive economic option.
- there are no major technical difficulties although an adequate metering system would be required.

- if CHP could eventually capture its total potential market of about 30 % of the national space and water heating load then energy saving of between 6 and 30 mtce would be achieved depending upon which alternative systems were available.
- the total capital cost of meeting 30 % of the heat load would be of the same order on other options, although less than for direct electrical heating and more than for SNG heating by heat plumps.

With these generally favourable conclusions but faced with major difficulties such as the current extremely competitive market price of gas which the Group believed precluded the unaided ›take-off‹ of district heating/CHP they sought a way forward.

Other potential obstacles included freedom of coice of fuels and disturbance while laying mains. The Group concluded that no simple decision was possible on CHP/district heating but that in order to have the option available in the longer term an early start should be made on at least one major lead-city scheme, perhaps linked to an inner-city redevelopment which would minimise some of the difficulties discussed.

Industrial CHP

Industrial CHP is economically applicable in many circumstances for process heating, drying, or space and water heating and the reject heat can be in the form of hot air, water or steam. The additional capital required for the CHP plant over and above that for a simpler boiler only installation with purchased electricity, is recovered from the savings consequent on the increased efficiency of energy conversion. Many industries, in particular the major process industries including paper, chemical and allied industry already have extensive CHP schemes. The Group estimated that about two thirds of the electricity generated privately in industry was associated with heat recovery resulting in a national primary energy saving of 2 to 3 mtce per year. An inquiry into private generation completed by the Department (copies available from the Department of Energy Library) since the CHP Group reported showed that over 190 establishments had CHP installations out of a total of 235 surveyed with private plant, which generated 17 TWh from 4.3 GW of capacity in 1977.

The extent of this existing development determined the type of study that the Group needed to undertake. There was obviously no need for the type of analysis carried out for district heating but it was necessary to identify any hindrances which might be limiting further development. The Group therefore set up a working party under the chairmanship of Mr. *Nick Britten* (ICI) to undertake this task. *Henry Stephens*, already known to Energy Management readers as the CBI's ›man of energy‹, was also deeply involved.

The Group included three types of applications in their deliberations.

- ESI owned schemes – This type is illustrated by the CEGB owned ›H‹ power station which supplies steam to British Celonese. A more recent example is the Midland Electricity Board's scheme now under construction at Hereford to supply steam and hot water to Bulmers and Sun Valley Poultry. In these schemes heat and electricity is sold to the industrialist with both himself and the ESI benefiting from the savings resulting from the recovery of the reject heat. The industrialist is also not required to tie up resources in plant of which he may have little expertise, and that plant is less likely to be duplicated on the ESI system since it can be programmed into their construction programme.

- Privately owned industrial estate schemes – Slough Industrial Estate is one of the few examples of this type of scheme which links the demands of a number of diverse requirements hence enabling the benefits of CHP to be gained by plants which might be less worthwhile independently.
- Privately owned individual schemes – These represent the majority of existing schemes where the industrialist owns and operates the scheme to his own requirements. The Group felt that the majority of such schemes which had been economic in historically prevailing conditions had already been implemented.

Studies undertaken by the Group

The Group tackled the task of identifying problems which might be inhibiting the further development of industrial CHP by means of the following investigations which are outlined in more detail in the report.

- Survey of Industrialists – The survey was conducted by consultants in collaboration with the CBI. It located 193 industrialists who had recently considered private generation of whom 171 completed questionnaires giving a broad understanding of the factors which had influenced their decisions. Discussions were held with 65 of those to obtain a deeper understanding and 7 CHP case studies were updated to more recent conditions to examine the economics and energy savings. CHP had been examined by 56 of those companies and 22 had implemented a scheme with a further eight still under consideration at the time.
- Study of Industrial Space Heating – it is well known that high load factor process loads can be economic with CHP. It was decided to investigate whether in future, lower load-factor applications such as space-heating might be economic if the capital cost for the plant could be offset against equivalent plant on the ESI system. A consultant therefore evaluated a space heating proposal using gas turbines or diesel engines supplying heat into factories and electricity into the ESI network but also to meet peak – lopping requirements on the ESI system. In this way the cost of separate ESI peak lopping plant could be offset against the scheme. No attempt was made to allocate costs or benefits between the ESI and industrialist although the plant was assumed to be on industrial premises but operated in cooperation with the ESI control arrangements.

- Implications of ESI and BGC Policy – it had been claimed that the policy of the ESI towards private generation and BGC towards sale of gas to gas turine CHP schemes were inhibiting further development and the Group therefore considered these issues.

Development of industrial CHP

All of the Groups deliberations led to the conclusion that the main factor which had contained development to its already well established state was straightforward economics. This together with other more marginal issues is discussed below.

- Investment criteria – The main reason why more technically adequate and energy saving schemes were not implemented was that the return on investment was not as attractive as the 2–4 year payback normally sought by industrialists.
- Willingness to invest – A number of companies preferred to make their investments in production facilities rather than energy conversion plant even where the economic return was adequate.
- Security of electricity supplies – Concern of the effects of past industrial action on electricity supplies had stimulated consideration of private generation.
- Impact of ESI policy on CHP – The Group's investigations on ‹standby› terms led them to believe these were reasonable and could have little quantitative impact on appraisals. Buyback terms were more problematic. The surveys showed that the majority of industrialists negotiated satisfactory terms but there was a feeling that the ESI's monopoly powers were inhibiting. The Group believe therefore that the ESI should seek to be as cooperative as possible both in negotiations and the provision of information.
- Heat/electricity balance – The Group felt that this was seldom a problem nowadays and that schemes should be designed to meet the factory heat load with the consequent electricity production and requirement being exchanged as necessary via a parallel connection with the ESI network.
- Load factor – The surveys illustrated that most successful schemes had a load factor over 50 % with many in the 60–80 % range.
- Impact of BGC policy – The Group felt that the current BGC market – related pricing policy might be inhibiting a small number of gas turbine schemes and hence recommended that the BGC should be sensitive to the needs of energy conservation in their negotiations.
- Future fuel availability and price – The Group felt that there would be an increasing emphasis on the use of coal for future schemes and appraisals should take into account likely rises in fuel costs during plant lifetimes.

- Information and expertise – Management resources were shown to be scarce and except for large companies, industrialists did not seem well placed to take advantage of available advice. The Group felt it important that if CHP were to extend into more applications further information and advice should be made readily available.

- Grants and taxes – Many of the appraisals reviewed did not take into account fully the relief afforded in this area and companies would therefore be further assisted by the availability of additional expertise.

- Legal considerations – The legal situation regarding private generation and the sale of heat and electricity did not appear to be widely known. The Group therefore attempted to review some of the legislation in the report but again further expertise could be made available.

Future prospects for industrial CHP

The case studies examined by the Group showed energy savings ranging from two to 53 %. This together with the existing extensive development shows that schemes can be economic and in the industrialists' and national interest. There is expected to be some further potential for development although this is likely to be of the more marginal schemes and where individual requirements can be combined into common installations under private or ESI ownership. The Group believe that this development should be stimulated by encouragement from the Government and the ESI. Government encouragement could take the form of

- setting up an information and advice service
- giving priority to CHP if any further finance is made available for energy conservation measures

What happens now?

The Government is currently considering the CHP Group recommendations. If in the meantime you are interested in the prospects of industrial CHP for your own case then the following assistance can be sought.

- The Chief Commercial Officer Director of your local electricity board is available for advice.

- You may be eligible for a grant towards the cost of a consultants' survey of your premises under the Energy Survey Scheme

- You may be eligible for a grant towards the cost of a CHP where you are replacing inefficient boilers of modernising/improving an existing scheme, under the Department of Industry's Energy Conservation Scheme.

Further reading

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[4] Greater London Heat Density Survey. W. S. Atkins & Partners - 1975. Dept. Energy Library (£ 3.25).

[5] Merseyside Heat Density Survey. W. S. Atkins & Partners - 1978. Dept. Energy Library (£ 3.25).

[6] Heat Load Density Study - Leeds. Kennedy & Donkin Associates - 1977. Dept. Energy Library (£ 1.50).

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[11] Report of Combined Power and Space Heating in Industry. McLellan & Partners - 1979. Dept. Energy Library (£ 2.00).

[12] Study of Combined Heat and Power and Electricity Generation in Industry. M & McLellan - 1976. Commercial-in-Confidence. Unrestricted sections ava from the Confederation of British Industry.

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CSO: 3102

NEW UNSINKABLE OFFSHORE PLATFORM DESIGN PRESENTED

Hamburg DER SPIEGEL in German 12 May 80 pp 241, 244

[Article: "A Little Nod"]

> [Excerpts] Is there an oil drilling platform which will not tip over? New platform models and the causes for the Kielland accident were discussed at a conference of offshore technicians in Houston.

The experts that had gathered in Houston did however agree that most of the drilling platform types installed in the North Sea or functioning as semi-immersed platforms for use far in the north are only conditionally functional. Their construction largely resembles the blueprints of the good weather drilling platforms used in the U.S. Gulf coast area.

Many outsiders are pushing themselves into the technically difficult field of offshore drilling. The Germans, for example, are offering an RS 35 model (ring structure, 35,000 tons of water displacement) in which the working platform floats on four columns which are connected to each other under water by a powerful pipe ring—diameter of 10 meters—and is reinforced (see drawing).

This pipe ring, as maintained by the conglomerate of firms led by the space travel firm ERNO in Bremen, assures excellent stability. Even an unusually high wave of 30 meters did not destabilize the ring construction as was shown in simulated tests at the Technical University in Berlin.

"It only bent a little," says Bauer who heads the RS-35 project for Erno. The "securement of the columns both above and below the water level," explained ship technician Prof Guenther Clauss of the Technical University, prevents anything "similar to that which occurred in Kielland from happening." Columns and the ring structure are protected by double walls; there are also four watertight bulkheads in the ring structure which become sealed in case of leaks and prevent any further intrusion of water.

Furthermore, the platform deck of the RS 35 is a watertight construction including the housing and working containers, as the technician explained.

Even in the case of an accident, "those seeing a movie would be sitting fearfully in a corner," says Clauss, "but they could be saved and would not be trapped as was the case on the Kielland."

The RS 35 conglomerate hopes to complete the remaining studies and tests by the end of next year for which the Federal Research Ministry spent DM 6.5 million. "Then," Bauer expressed the hope, "we can begin to build."

But it is still uncertain for whom it can be built. The drilling market has been dominated for decades by the Americans. Only the English, Scandinavians or French had outsider chances up to now.

But even there, the Berliner Clauss has some advice. He recommends the European Jumbo Airbus as a model "when they first went to the villages to make some sales," and only then did the larger airline companies become convinced of the efficiency and technical maturity of the European aircraft and ordered it.

Something like this, the professor from Berlin said last week in Houston, could also occur to the RS 35 platform: "It has the makings of becoming the airbus of the seven seas."

The semi-immersed platform with 35,000 tons of water displacement can operate in water depths of up to 1000 meters (maximum drilling depth of 6000 meters). The drilling platform can be maintained at water depths up to 600 meters by means of eight anchors; for greater depths, screw drives at the four columns and a computer control mechanism assure maintained position. The platform (total height of over 100 meters; diameter of 96 meters), when towed has a depth of 9.1 meters and a depth of 29 meters when used for drilling purposes.

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ENERGY

BRIEFS

SOLAR ENERGY COMMISSION LOOKS TO BIOMASS--The oil crisis has made it possible to rediscover an energy source as old as the world, biomass, or green energy. Studies begun several years ago are witnessing a considerable surge. From 3 million francs in 1979, the budget devoted to biomass rose to a total of 55 million francs this year, taking all the contributions together. This prompted Henry Durand, president of the COMES [Solar Energy Commission] to call 1980 the Year One of green energy. A "green program" of development of the energy utilization of biomass has been launched and 10 subsidized pilot operations which should be followed by many others. The goal is to produce 10 million tons of petroleum equivalent (TEP) by the year 2000, and perhaps two or three times as much by 2050. [Excerpt] [Paris LE MONDE in French 18 May 80 p 8] 6108

PILOT COAL GASIFICATION PLANT--Paris--Projected construction of a coal gasification pilot plant at Le Havre--a coal-gasification pilot plant, using the American process perfected by Texaco and exclusively French materiel will soon be installed in Le Havre by Creusot-Loire, it was learned from the company on 6 May. Inauguration could take place at the end of 1981, and would process 15 tons of imported coal a day. The oxy-vapo-gasification process to produce synthetic gas consists of utilizing oxygen and steam at 15,000 degrees. This method makes it possible to use all types of coal, for there are no problems of ash or agglomeration. The Le Havre site was chosen because of the size of coal imports in this port. Users would be oil companies and chemical complexes, and subsequently Gaz de France for the supply of households. If the experience is conclusive, a commercial scale plant would be built to treat 300 tons of coal a day and producing 150,000 cubic meters of gas per day. By 1985 a certain number of 2,000-ton gasification units could be created, said the Creusot Loire company. [Text] [Paris AFP SCIENCES in French 8 May 80 p 27]

CSO: 3102

INDUSTRIAL TECHNOLOGY

WELDING ROBOTS, APPLICATIONS DISCUSSED

Paris LE NOUVEL AUTOMATISME in French Apr 80 pp 33-38

[Article by Ensem Doctor Engineer Marc Ferretti, MSc: "Welding Robots and Their Application"]

[Text] The concept of the universal robot has been greatly disparaged: too costly and industrially insufficiently profitable, universality yielded to specialization. It was thus that robots were developed for painting, welding, handling...most of which were initially applied in the automotive industry. This polarization of the market by the automobile does not detract from the interest shown by other industries. Along wigh information we are presenting on the general development of robotics, we are undertaking the publication of sectorial application studies. The first, displayed at the machine tool biennial exhibition dealt with soldering: the robots exhibited were robust machine tools programmed for work in a hostile environment. Their operation no longer causes problems.

Long ago the blacksmith learned the art of making the ends of metal parts white hot and then welding them with a hammer. As early as the seventh century rolling consisted of stretching a heated metal rod which was turned into short and thin blades whose sides, folded back, were partially welded so that lines and ripples could show. Gradually, efforts were made to weld totally iron possessing specific qualities: flexible for the blade part and hard for the cutting part.

However, over 1,000 years had to pass before machines which could insure mass production became widespread: After 1860 the hydraulic press, bolt-nut precision threading, the drop hammer, followed by machine tools, etc., radically changed industrial life. Techniques began to rely on scientific

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* See: "Industrial Robotics File: Initial Balances" and "Toward the Third Generation," in issues Nos 1 and 2 of September, October and November, 1978, as well as "Artificial Intelligence and Industrial Robotics," in Nos 6 and 7 of May and June-July, 1979.

research. That is why we owe the American Elihu Thomson numerous inventions in the field of electricity, resistance electric welding in particular, developed in 1877. Ten years later, James Prescott Joule published a note describing the required conditions for electric welding.

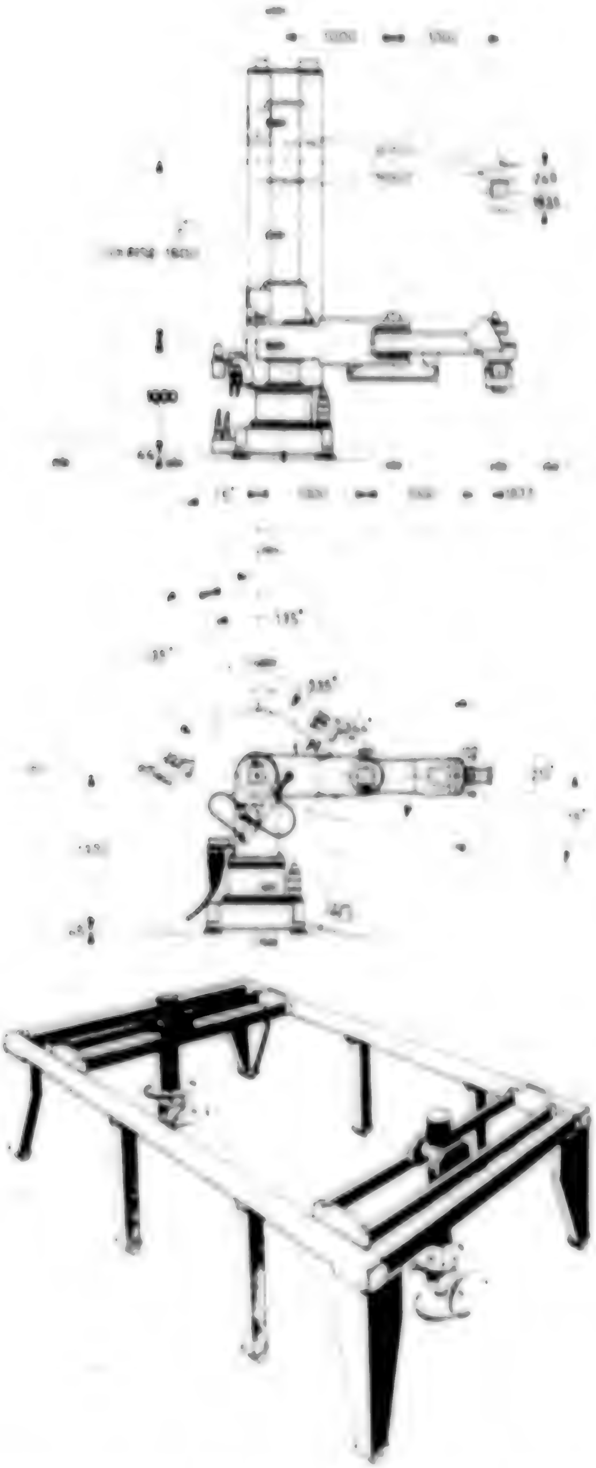
The first electric welding machines appeared in plants and workshops at the turn of the century: Gradually seam welding replaced the traditional rivet, whereas butt welding replaced the drop hammer. Today the "double pickled" soft sheets, and stamping presses, combined with the intensive use of spot and seam welding, have made possible the development of bodies which the automotive industry produces by the millions.

In terms of the automation of welding materials, Dr Otto Becker of Duisburg University has suggested a theoretical classification broken down into a number of stages as shown in the following table.

Welding Automation Stages

No automation	Manual electrode welding
Partial automation	Semiautomatic welding
Total automation	Automatic welding machines with flux welding or with gas shielding with fusible electrodes
Automation	Same machines as above but even the handling of the parts becomes automatic
Automation with preselected programming	Automation as above but even the welding parameters are set according to predetermined values. Information support may come from a punched card, punched tape, or magnetic tape.
Automation with self-programming	Same degree as above but, furthermore, the electrode detects the joint and follows it. The welding parameters adapt to operational conditions and variations of the part. This modifies one or several parameters.
Automation with optimum programming (under study)	All pertinent quantities are measured. The machine itself measures the welding parameters, the number of beads, and the range of eventual oscillations... It avoids all defects and maximum welding quality is achieved.

At Flins the Renault 18 is assembled at a minimum pace of 900 cars daily; 11 welding robots account for 82 percent of the spot welds, or 3,735 of the 4,550 necessary spots which converts a set of stamped steel sheets into a car.



The three robot models of the Renault family: horizontal and vertical, with their clearances, and the gantry robot.

The Robot and Difficult Tasks

In these automobile plants the arrival of the welding robot made more people happy than unhappy. It performs physically difficult jobs and, in the majority of cases, the individual it replaces oversees the machine. That is what explains the fact that the automobile, and everything gravitating around it, accounts today for over 50 percent of the market in robotics and that, furthermore, it is one of the only sectors extensively investing in this area.

We must also acknowledge the fact that the still rather uneven reliability of the robot hinders the broadening of the market and favors internal solutions within the big enterprises: That is why the development of the robot program at Regie Renault, started by the Automation Office, is being industrially pursued in one of the branches of the Regie, the Acma-Cribier Company, which manufactures and assembles in its Beauchamp plant the various robot models designed by Renault.

With a maximum useful load of 80 kilograms, such robots can hold a 70 kilogram clamp and weld at a pace of one weld per second with a half-millimeter precision. The different models developed on the basis of the same technology are designed on the basis of a modular technology which makes it possible to adapt the design of a robot to its purpose. Different morphological assemblies could thus be obtained by putting together identical base modules: turning tables, joints, translations, grips, etc., used in designing horizontal, vertical, or gantry robots which could hold several welding arms. In Flins each gantry is installed across the assembly line and has two welding arms each operating on one side of the body.

The trajectories followed by such welding robots are recorded point by point; an operator moves step by step the manipulator in each of the desired positions with the conventional manual push-button box. This is a difficult procedure, particularly when a single shift requires the combination of six turns!

This difficulty is eliminated by a "syntaxer " handlebar with a range of six degrees. This is a developed manual command which makes it possible to guide shifts intuitively: The necessary geometric changes are made by a real time calculator which automatically formulates the proper orders for each of the axles. In order to obtain a continuous trajectory the calculator automatically adds intermediary points in order to achieve the shortest possible shifting time while retaining the mechanical characteristics of the system. This trajectory could be changed before or after in order to avoid an obstacle which would hinder the motions of the robot. It consists of predicting or interjecting between the stops the "passing points" which must be necessarily crossed by the robot.

Twenty-one welding robots were installed at Renault in 1979, most of them in Flins, along the final assembly line of the Renault 18. Other automobile manufacturers have also been interested in robotics: Thus, Volkswagen has marketed a series of robots whose payload ranges from 15 to 100 kilograms. In Italy Fiat is building robots at its Comau branch.

Renault-Acma vertical robot armed with a welding grip.

Positioning and Welding Robots

Welding is a specialized job: For example, knowing how to limit the temperature merely to the area of the welding spot in order to heat as little as possible uninvolved areas is one of the know-how features of welders. That is why the automobile industry has joined specialized designers such as Languepin SAF or Sciaky to develop welding robots or find specific uses for them.

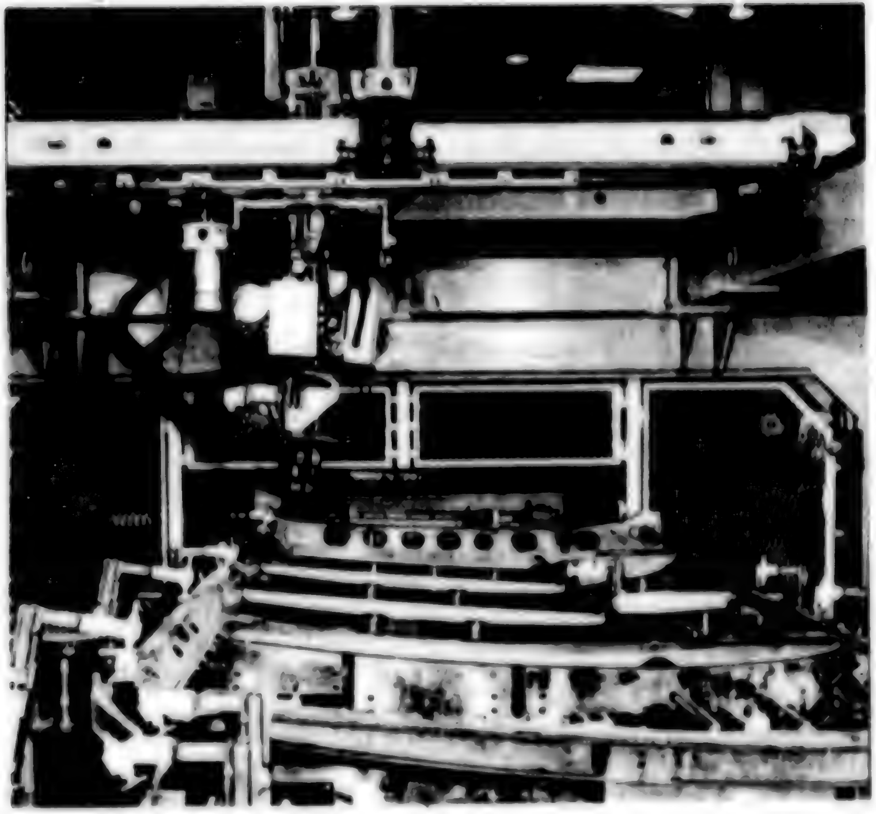
Sciaky emphasizes modularity and offers mechanized elements which could be programmed individually: Handles which, through a combination of

Part of a Sciaky welding center along a welding transfer line of automobile panels: a manipulator with three programmed shafts.

rotations, make it possible to direct the linear modules (arm, upright, and linear collar) within a one-three degrees range.

In turn, Languepin has two robots, the Robolang 15 and 50, whose payloads are, respectively, 15 and 50 kilograms and which may have six programmable shafts; the corresponding programmable moving units are digitally controlled tool-carriages. These shafts could be linked with other shafts thus forming programmed assemblies with two-three, or four shafts used for assembling sheet-iron parts; naturally, they are applied in automobile manufacturing but also in electrical appliances, metal furniture, etc.

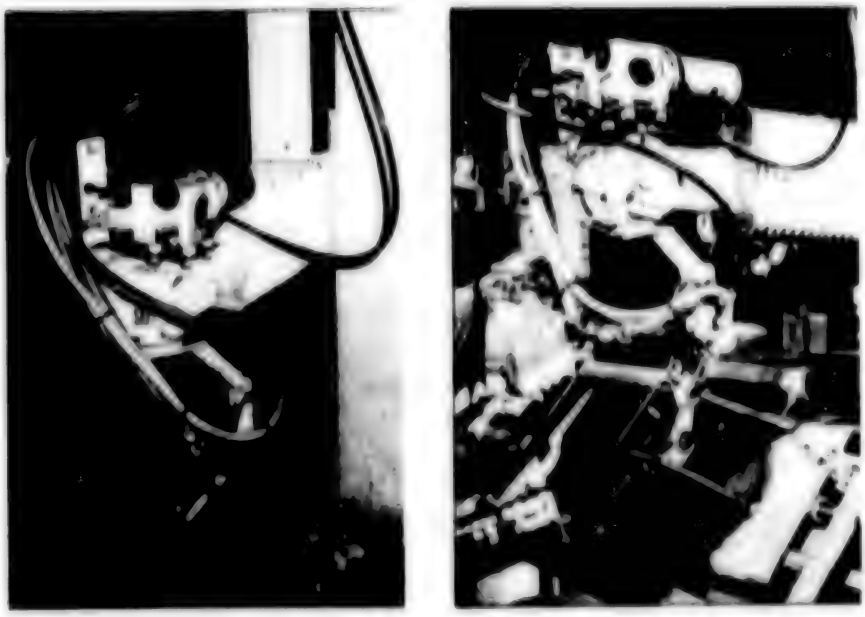
In turn, the SAF developed, together with Languepin, a series of machines with programmable shafts based on the Robolang, with a 15 kilogram payload. Their programming is achieved by positioning the tool through a manual command panel at different points of the trajectory. A push-button then records the position of the tool. Furthermore, trajectories could be modified with instructions such as "change," "add," or "delete." The robot can be used for several types of weldings such as resistance, MIG, plasma cutting, etc. This installation is used in MIG welding of the frames of dump trucks, double welding of a front bumper on the frame and, outside automobile manufacturing, in the making of metal office furniture. Unlike conventional welding robots which control the movement of the welding unit, the Lambert and Jouty positioning robot makes it possible automatically to direct the plate supporting the welding pieces thus handing them most conveniently to the operator. The welding



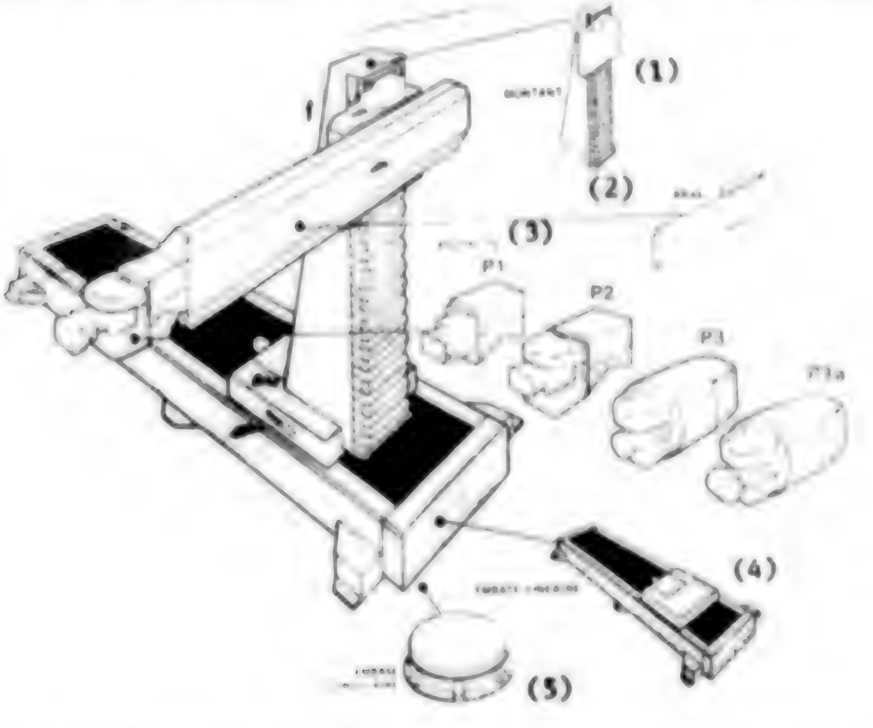
Languepin has developed this gantry robot shown on the cover of the present issue: It welds the lateral panels of automotive vehicles (see page 3).

operation remains manual but has been made easier: Parts which could weigh several tons are presented at the best possible angle. Such an optimum position insures better work quality while reducing the fatigue of the welder.

This machine is used in machine construction workshops where welding operations are complex and where series production is not sufficiently important to justify total automation. The robot has three controlled movement shafts of reduced precision which, nevertheless, remain adequate for this type of operation. The programming of the movements is learned through practical experience and the memory bank could contain several "parts-programs" with 500 basic movements each.

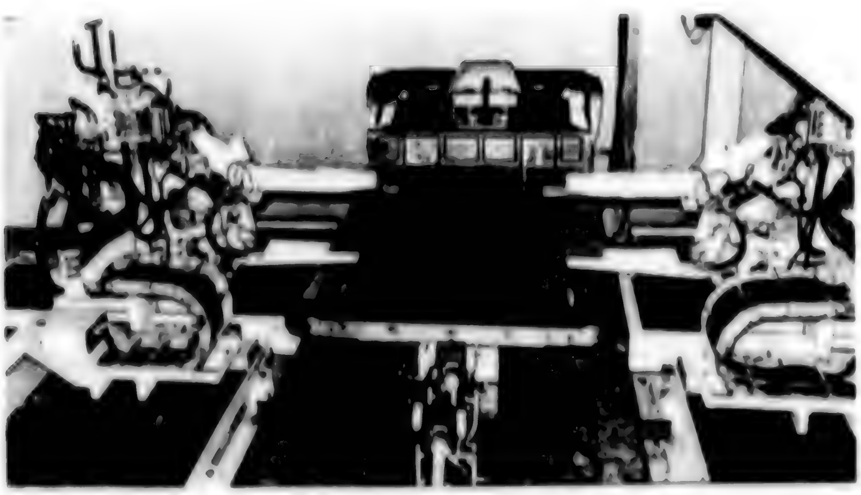


Right: The Robolang has been especially designed for welding use: welding system with an MIG automatic poking. Left: Robolang programming



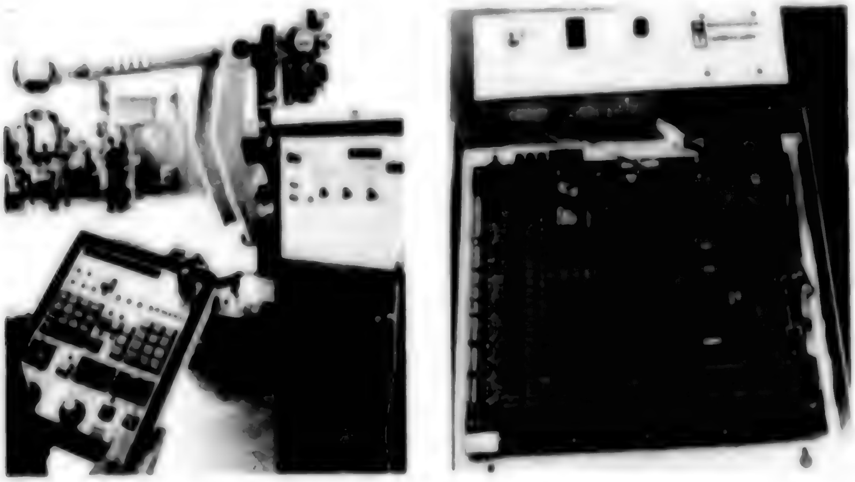
Sciaky modular elements for the assembly of robots as required. Movements controlled by a control box activating each group of line shafts.

Key: 1. Upright; 2. Arm; 3. Handles; 4. Linear base; 5. Circular base.

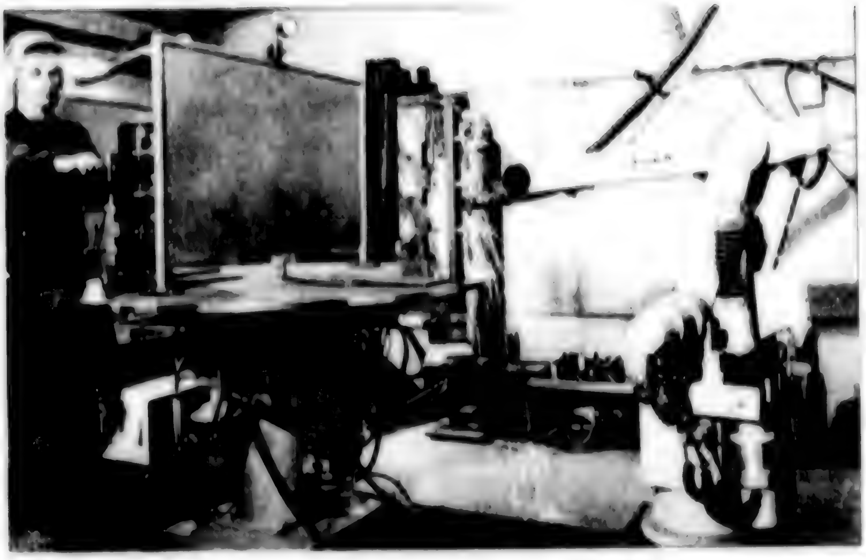


Mechanized handles connected with programmed shafts controlled through microprocessors, used for the welding of bottoms and panels of utility vehicles.

The Lambert-Jouty robot has a mechanical part capable of two or three movements, and a telemechanic automation box controlled by an Intel 8085 microprocessor card, developed and manufactured by Option; the command panel was described on page 45 of issue No 11 of last January-February.



Right: Command panel of the Lambert and Jouty positioning robot: developed by Option with Intel 8085 microprocessor card. Left: Robot Kuka-Aro 601/60 for spot welding with its Siemens control system in the course of a programming operation.



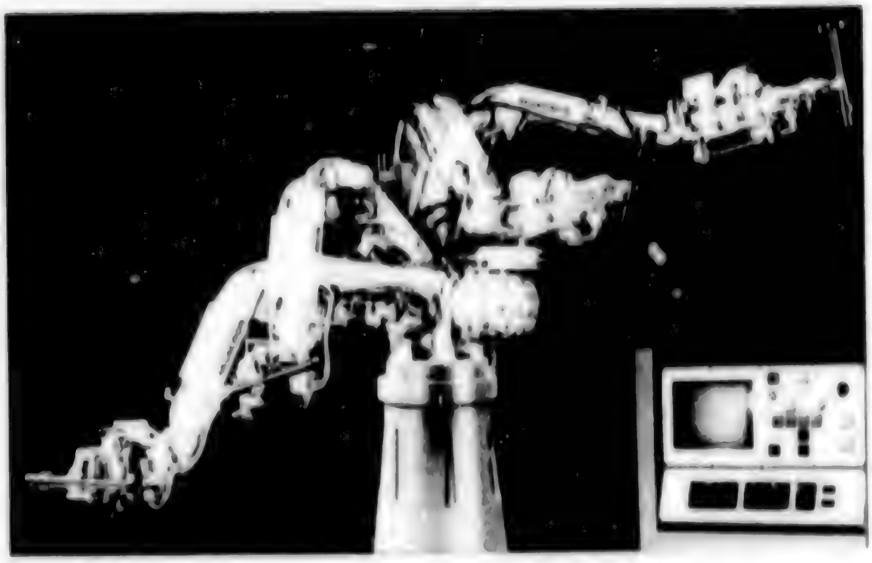
At Briab Arboga arc welding by robot of truck trailers. The replaced operator merely supervises the machine.

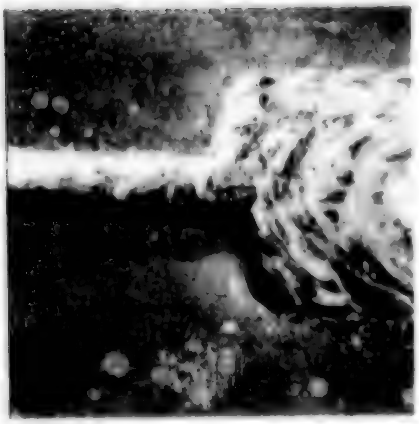
More Universal Robots

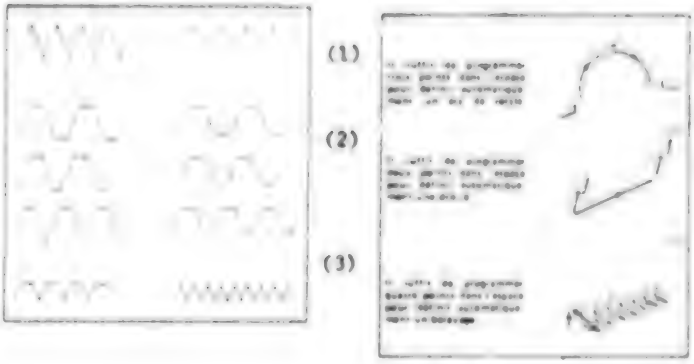
The Unimate robot is the product of a line of universal robots conceived 20 years ago by the American Unimation Company. Today such robots are found almost everywhere: At Flins a Unimate works in assembling Renault 18 cars; on the assembly line of the Renault 5 bodies the Regie uses another robot put together by Sciaky. Fiat asked Languepin to study and produce a transfer line equipped with six Unimate robots working simultaneously on either side for a total of 138 welding spots for the final assembling of Ritmo front block. Thus, Fiat has a total of almost 200 Unimates!

At Volvo, in Torslanda, not far from Goteborg, there are 27 Unimate robots. General Motors uses many Unimates in its Lordstown, Ohio, plants. Chrysler has installed several lines of such welding robots in its Belvidere, Newark, and St. Louis plants. All in all, this amounts to over 2,000 Unimate robots in operation.

In Europe the counterpart provided by Asea which has already sold 500 robots, 150 of which for arc welding and 70 for spot welding. Half of the Asea robot market is focused on its IRB 6 model, priced at approximately 350,000 francs, with a six kilogram payload, and the IRB-60 costing approximately 570,000 francs, with a 60 kilogram payload. These models could be equipped with manual adaptable controlled pickups.

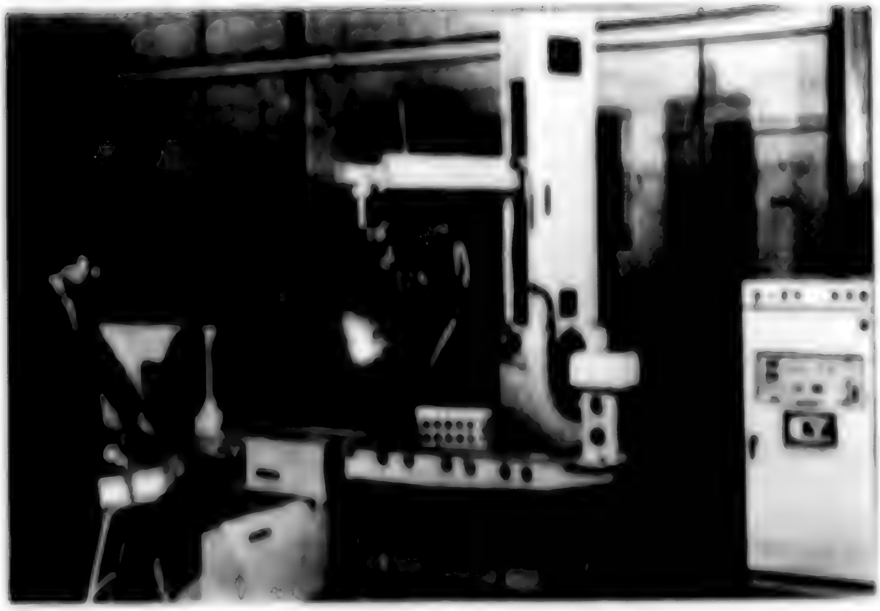






In arc welding, at a given point, the welder must make more or less complex movements. Should the size of the welding joint become extensive, robot T_3 of the Cincinnati Milacron could make triangular or trapezoidal movements already programmed in its memory bank.

1. Suffice it to program three points in space to define automatically an arc.
2. Suffice it to program two points in space to define automatically a straight line.
3. Suffice it to program four points in space to define automatically a sweep.



Welding robots frequently have control systems used to facilitate programming. Such is the case of the CY 751, a five-shaft Japanese robot manufactured by Shin Meiwa, marketed by Commercy Soudure.

Abroad, robotics is most intensively developed in Japan. It is said that Japan has some 70,000 robots, half of them programmable, with an annual output of 10,000 units. The figures are controversial, for they include all types of robots some of which are very primitive.

All automobile manufacturers use robots. This applies to small ones such as Fuji Heavy Industries, which produces 500,000 Subaru cars per year. Toyota uses Unimate robots; Nissan and Toshiba have developed a robot with three positions--the Tosman 200--used along the Nissan assembly lines. Let us also note the Unimate 6060 gantry robot with eight arms, manufactured by Kawaski Heavy Industries, under Unimation license.

Currently the Japanese are interested in arc welding and the development of special arc welding robots. Kobe Steel designed and manufactured the six-position Arcman robot. Three such robots are already operational at Iwaya.

The penetration of Japanese industrial robots in Europe is going on: Following the agreements reached between the West German Durr Company and Hitachi for the marketing of Japanese painting robots, last January Sciaky bought a license from Mitsubishi for the manufacturing of spot welding robots in France. Finally, let us point out that Commercy

Soudure imports and markets as SY 751 a five-shaft welding robot of Japanese Shin Meiwa origin: Its positioning precision is 0.5 millimeters for 150 millimeter welds.

Unquestionably, we shall have the opportunity to see other units in June, in the next Machine Tool Biennial, to complete this initial survey of the use of welding robots.

5157
CSO: 3102

NEW INDUSTRIAL ROBOT DESCRIBED

Paris SCIENCES & AVENIR in French Apr 80 p 4

[Text] Text of letter from Professor H. Place, official in charge of LATEA: "I read with considerable interest your data on "The Robots" (March 1980, pp 46-64) which I found well documented; nevertheless the insert of p 56 (robot industry in France) left out our laboratory (Laboratory of Applications of Advanced Electronic Techniques of the INSA of Rennes) although it has been devoted for 3 years to the robot sector, and in particular the creation of a mobile robot, capable when moving, to avoid obstacles located on its path (with the financial support of CNRS [National Scientific Research Center]). This implementation is almost completed and the simulation of the strategies of displacement of this robot has been adjusted perfectly. Could you bring your readers up to date on this point?"

To complete our readers' information, this is the constitution of the mobile robot of Rennes for which the designers sought simplicity above all.

It consists of 4 main elements:

--an electrical carriage of circular structure such that its instantaneous axis of rotation may coincide with its geometrical axis of revolution; the choice of the two motor wheels located at the end of a diameter and turning in the opposite direction at the same speed permits in particular the rotation of the carriage on itself;

--an obstacle detection system (rotary telescopic arm equipped with a close grip) and an alarm device (safety arch surrounding the carriage and indicating the area of impact with an obstacle). The collectors have been chosen of the hit or miss type to prevent complex informatic processing; the previous experience of processing of the signal supplied to a photodiode camera led us to making this choice;

--a decentralized modular informatic structure built around identical microprocessors, permitting study and implementation in independent and embarked subsystems (motor wheels, rotary telescopic arm, safety arch) and remote controlled communication with a central minicalculator;

--a displacement strategy based on an alternation of straight lines and rotations leading the robot to a prefixed goal, avoiding like a blind man, the obstacles located on its path.

9018
CSO: 3102

INDUSTRIAL TECHNOLOGY

COMPUTER-ASSISTED RESEARCH: PROGRESS REPORT

Paris INDUSTRIES & TECHNIQUES in French 30 Apr 80 p 8

[Text] At the beginning of April the Council of Ministers heard a report by Pierre Aigrain, state secretary for research, and Andre Giraud, minister for industry, on the development of data banks. To the minister of industry, this development is "capital for the future of France," for it enhances "not only the dissemination of French culture," but also, thanks to the storage of industrial data, patents, or normas, "the economic future of the country."

Since the measures taken by the government in 1977 to set up data banks, seven computers, linked to telematic "Transpac" and "Euronet" data transmission networks, now permit access to data banks. Twenty numerical data banks were created in 1979 and new appeals for bids will be issued in 1980 to promote projects in more important fields of specialized information.

Besides recourse to scientific and technical-industrial data banks, the ministers stressed the importance of "interactive data banks." These banks, like the Thermodata, or biometric data bank, no longer provide just raw data, but make it possible to solve certain problems--for example, replying to questions of ergonomic calculation or design (biometry) or chemical cinetic calculations (Thermodata).

It is therefore a question of a real "pre-calculation" service which computer assisted research [CAR] permits. Why go over the same road traveled by other researchers or engineers? It is better to skip over what is already known, thanks to the computer, and attack directly the new problem raised.

It may seem that the prospect of development of CAR, a vast centralization of the "calculation potential" would be desirable. Present officials in charge of policy in this field nevertheless lean toward increasing decentralization. This is another aspect of the problem raised by the "apportioned intelligence."

[Photo Caption] Launching of a data transfer satellite like "Telecom 1"--under development at Matra--will open up a royal road to the flow of documentation across national boundaries.

6108
CSO: 3102

BUDGET, ORGANIZATION OF RESEARCH IN FRANCE

Paris LE MONDE in French 22 Feb 80 p 12

[Article by Maurice Arvonny: "'First-Ranking Scientist' Will Assist Mr Aigrain in Advancing Biotechnology"]

> [Text] Mr Pierre Aigrain, secretary of state in the office of the premier in charge of research, on Wednesday, 20 February, presented the decisions made in recent weeks and confirmed that morning by the Cabinet concerning the applications of biology. Before that however the secretary of state had commented on various projects relating to the general organization of research in France.

Mr Aigrain held several press conferences, surrounded by his close aides, at the Broglie Hotel, which houses his secretariat of state, as well as the DGRST (General Delegation for Scientific and Technological Research) which is its secular arm. But on that Wednesday, he received the press in an annex to Matignon House, surrounded by representatives of numerous ministries. This was perhaps a "coincidence in terms of space and time" --to use the phrase which he employed in talking about the resignation of DGRST Director Roland Morin (LE MONDE, 17-18 February). On that occasion, he talked more in his capacity as secretary of state attached to the office of the premier rather than as secretary of state in charge of research.

"I do not want to pull anything fancy," Mr Aigrain had said shortly after taking over in April 1978, meaning that he did not demand running any research organization. All he wanted to do was to propose overall guidelines to the administration and he wanted to do that by bringing about arbitration on financial matters among the organizations whose budgets are grouped together within the "research envelope." He has available the Research Fund--amounting to about F450 million in 1980--to launch programs on topics which are either too new or too interdisciplinary to fit easily into the existing frameworks.

This situation is rather disadvantageous: the minister in charge--no matter how little his view may differ from those of the secretary of state--can easily block the latter's action. There are only slight differences between the reform of the CNRS (National Scientific Research Center) which the secretary of state for research planned in the autumn of 1978, on the one hand, and the text published a year later under to aegis of the minister of universities, on the other hand. And since this involves big research outfits which are under the Ministry of Industry, it is quite obvious that the options of Mr Andre Giraud only partly cover those of Mr Aigrain. Mr Giraud talked a lot about innovation--a word which ought to be explained somewhat more--and he is having trouble adjusting to the control which the DGRST can exercise over the portion of his budget which comes under the heading of research envelope.

Hence, some pessimistic hypotheses formulated recently on the future of that envelope and, more generally, on the future of the secretariat of state. These assumptions have alerted some journalists but also some men of science who hold important responsible positions in the French research organization.

Financial Implications

At the cabinet session devoted to biology this was an opportunity for Mr Aigrain to assert, with a certain degree of solemnity, that these worries are groundless, recalling that, in 1977, "a government position was created under the premier" for research, that "this agency is destined to last," and that he would continue the current policy calling for an increase in research funds "in spite of the budget limitations on nonobligatory expenditures," an increase which is heavily held down by inflation. But Mr Aigrain noted specifically that the "rate of inflation on research expenditures is currently less than the general rate" because the prices of scientific instruments are greatly correlated with the dollar which has been depreciated with respect to the franc. And he reaffirmed that "the administration is determined, in the years to come, to step up the nation's research effort on the part of the enterprises and the government" and that "this effort will remain an overall, interministerial effort, coordinated by the secretary of state for research."

As for the resignation of Mr Morin, it had been expected for a long time and "there is no need to come up with any interpretations as to his departure." The press thus was wrong when it revealed that this departure coincided with the start of a study on a reform of the role of the DGRST and that there was an indication of conflict.

Mr Aigrain then commented on the decisions which the cabinet had just made in the field of biotechnology, based on the report prepared by Messrs Francois Gros, Francois Jacob, and Pierre Royer (LE MONDE, 14-17 November 1979). Biology has reached a stage where practical applications are close and are "very feasible for France" in view of their characteristics: strong added value, low consumption of raw materials, low consumption--

perhaps even production--of energy, small material investments. On the other hand however much is required in the way of investments in research, in personnel training, and in the adaptation of industry. Hence, a series of actions which are going to be taken by the various ministries concerned.

Regarding personnel training, which is the limiting factor in the short run, the Ministry of Universities is going to develop the third biological sciences cycles; the Ministry of Agriculture will conduct a parallel effort in the area of higher agricultural teaching and "indoctrination" will be generally organized in the engineering schools. The Ministry of Agriculture will take the measures necessary "to give the National Institute of Agronomic Research closer contact with farmers and manufacturers in the agricultural sector and it will speed up the preparation of pedological maps (soil maps), as well as hydrologic and weather maps" for France. The Ministry of Health will take steps to develop biomedical instrumentation as well as the manufacture of biomaterials and it will encourage the production of reagents. Finally, the Ministry of Industry, which has established study groups on how to stimulate industry to engage in advanced-technology activities, will, in the area of biotechnology, take steps aimed at industrial reorganization; contracts will be signed, starting this year, between the government and the manufacturers in order to promote the industrialization of biological techniques.

In response to questions concerning the cost of these measures, Mr Aigrain indicated that it was low in 1980 (it takes a certain time for these actions to start up) and that the current budget provides sufficient funds. But the decisions which have just been made will have important financial implications during the year to come.

Mr Aigrain finally announced that, to assist in the coordination of various ministerial actions, a "Mr Biotechnology" will shortly be appointed to assist him and that man will be a "top-ranking scientist."

5058
CSO:3102

FRANCE-MEXICO ECONOMIC COOPERATION PLANNED

Paris AFP SCIENCES in French 22 May 80 p 1

[Text] In response to an invitation from the President of the French Republic, Mr Lopez Portillo, the Mexican president, paid an official visit to France from 16-18 May.

Many people took part in the talks. On the French side, we should mention the presence of the minister of industry, Mr Andre Giraud, and Mr Pierre Aigrain, Secretary of State under the Prime Minister (Research).

The two presidents expressed their wish to provide a lively stimulus to the Franco-Mexican economic cooperations in the sectors of common interest and promote the implementation of important projects under study or negotiation, concerning in particular:

--city and railroad transportation;

--telecommunications: France supplied two telephone exchanges to Mexico. CIT Alcatel (subsidiary of CGE [General Confederation of Electricity] and Thomson-CSF have been preelected within the framework of a call for bids for the supply of 40,000 lines. They are competing with 3 foreign companies and 2 local producers. It is believed that TELMEX (the Mexican PTT) will choose 3 suppliers, but competition is close.

In the sector of Hertzian beams and radars, Thomson is hoping to obtain new markets. The manufacture of the products could be carried out in the factory of radiological equipment which Thomson has already set up in Mexico.

--Automobile and component industry;

--Chemistry and petrochemistry: the State company PEMEX (whose general manager, Mr Jorge Diaz Serrano was in Paris) may be prepared to sell oil at preferential prices to the production units which the French chemical engineers would agree to set up in Mexico.

--Port and fisheries infrastructures;

--Mines and metallurgy;

--Agricultural and food sector: the Mexicans are interested in French techniques and would like to develop a cattle-breeding-meat-milk production and transformation network.

--Nuclear energy: the negotiations between the French Atomic Energy Commission and its Mexican partners have led to the signing on May 19 of two agreements of cooperation.

9018
CSO: 3102

SCIENCE POLICY

TECHNOLOGY TRANSFER IN EXCHANGE FOR MEXICAN OIL DESIRED

Paris LE MONDE in French 17 May 80 p 3

[Article by Jean-Michel Quatrepoint: "Mexican Oil for French Technology?"]

> [Text] Oil, technology transfers, French investments in Mexico are the focus of French-Mexican talks in Paris.

Will Mexico become, over the next decade, one of France's main suppliers of petroleum? This question forms the backdrop for the talks. A 10 year contract was already signed in 1979 by Mexico and the Compagnie francaise des petroles [French Petroleum Company]. It provides for the delivery of 100,000 barrels per day (5 million tons per year) of crude oil, a rate which should be reached progressively during the current year. Now, it is said that the Mexican delegation intends to propose to France a broader and longterm agreement for oil supply. They would propose guaranteeing a doubling or even quadrupling of the volume of sales, which would rise their total to 10 million or 20 million tons (i.e., between 10 percent and 20 percent of French requirements), with Mexico setting its charges on the basis of those of OPEC.

Such a proposal would have the value of reducing France's dependency on Middle East oil. But it would pose a delicate problem of rebalancing the trade.

For a long time, Mexico has complained about the unequal trade balance in favor of France. A situation which will flip over in 1980 with the start of the CFP [expansion unknown] contract. From being in France's favor (991 million francs in 1978 and 1.6 billion francs in 1979), the balance will become clearly unfavorable, since one million tons of oil are worth, at the current rate, 1 billion francs. It would thus be necessary to correspondingly increase French sales (2.1 billion francs in 1979) by very substantial proportions.

This will not be easy, because Mexico does not want to tie its oil sales to a swap agreement. It prefers to keep a free rein to purchase its goods and equipment at the best price, by playing on world competition. On the other hand, the Mexican authorities would hope that, in exchange for this oil guarantee, the French Government and industrialists would participate in the industrial development of the country, particularly by way of technology transfers and local investments (in association with Mexican capital).

To date a certain number of specific technological cooperation agreements (nuclear, telecommunications, space) have been signed between government agencies of the two countries. A few French firms have set up factories in Mexico in association with local investors (Renault, Moulinex, Creusot-Loire, Novotel, Poclain, CGE, Thomson). But this French presence is very weak compared to that of the United States, obviously, but also to that of Japan, which has invested in Mexico in recent years four times as much as France (200 million francs in 1979). French investments represent only 10 percent of the total of foreign investment (excluding the United States).

No doubt they understood faster in Tokyo the desire of the Mexican authorities to free themselves as much as possible from their powerful neighbor. A desire which goes hand in hand with Mexico's emergence as a large oil producer and its ambition to play a major role in Central America and the Caribbean.

Regaining Lost Control

Certainly, for the past 2 years France has been trying to regain the lost ground. Paris opened a 1 billion franc line of credit for Mexico to purchase French equipment. But, as has been seen, that nation insists on technology transfers. Several "tracks" will thus be explored during the talks between the Mexican delegation and the French public agencies and industrialists.

Agriculture and food: Highly interested in French technology, the Mexicans would like to develop a livestock raising - meat - milk circuit for production and processing. Modern facilities would thus be set up locally, employing poor peasants as workers.

Equipping mines of all types (coal, iron, copper, silver) offers outlets for French technology, with the majority of the equipment being locally manufacturable.

Telecommunications: France has supplied two telephone exchanges to Mexico. CIT-Alcatel (subsidiary of CGE) and Thomson-CSF have prequalified in a request for proposals for supply of forty thousand "temporary" lines. They are competing against three foreign firms and two local contractors: a 51 percent "Mexicanized" subsidiary of ITT and a subsidiary of the Swedish Ericson group. This request for proposals is the first of a long series, since Mexico plans to install ten million lines in the next ten years.

It is believed that Telmex (the Mexican telephone company) will select three suppliers. Since the two local contractors have every chance of being selected, there would remain a place for only one newcomer. This one, whoever it is, would have to set up an on-site production plant. CIT-Alcatel is nourishing a few hopes, but the Japanese appear in a better position.

In the area of microwave systems and radar, Thomson hopes to obtain new contracts. Production can be done in the radiological equipment plant that Thomson-CSF has in Mexico.

Atomic power: The master cooperation agreement signed in 1979 with the AEC covers:

1) Prospecting, mining and processing of uranium;

2) Supply of enriched uranium in France;

3) Preparation of Mexican industry, with the participation of France, for the possible construction of nuclear power plants. However, this agreement is still in the beginning stages. For the moment, in Mexico they are hesitant to develop nuclear power on a massive scale and go beyond the two power plants under construction.

Petrochemicals: The government corporation Pemex would be willing to sell oil at preferential prices to production complexes which the French chemists would agree to set up in Mexico.

This list is not exhaustive. But, given the preponderant positions of the United States, the Japanese and German competition, the needs of Mexico, the French technology capabilities, the reluctance of a portion of French industry owners to invest in countries that they don't know very well, one must not, in the short run, expect any miracles.

The process of technology is long and complex. In order that it fully benefit both the "receiver" and the "giver," it must be accompanied by a less spectacular but equally important effort at the cultural level. But in this connection, one cannot help but notice the retreat of French influence in this area of the world, beginning with that of the language.

9550
CSO: 3102

EURONET-DIANE CAPACITIES, TECHNIQUES DESCRIBED

Rome SCIENZA & VITA NUOVA in Italian May 80 p 93

[Article by G.M.: "From Node to Node, So Many Coded Packets"]

[Text] The advent of distributed data-processing--first as a means, and then as a philosophy, of automatic data-processing--has given a new impulse to the designing and building of data-processing networks, understood as systems for connection between users and data banks through telecommunications lines--telephone lines, coaxial cables, waveguides, transceivers, satellites, and in the future, optical fibres.

EURONET is a nodal network. It presently has four nodes, located in London, Rome, Paris and Frankfurt, connected by telephone lines with the high transmission speed of 48 kilobits per second (48 kbit/s). The nodes receive the messages both from the service centers through the concentrators, with medium-speed telephone lines of 9,600 bit/s, and from the adjacent nodes. Each node manages its traffic by the "store and forward" criterion, selecting for each communication block the route that is most suitable, and not necessarily the shortest one. The storage criterion facilitates the use of the network between nodes, the network having a transport capacity five times greater than the lines that connect the service centers to the nodes.

Storage is necessary for management of the messages of the users, who are connected to the network through a concentrator capable of receiving at low speed from public telephone lines at 110 bit/s or from private-status lines at 1,200 bit/s. The less sophisticated user has a keyboard terminal with which he can work only at very low speeds. The more sophisticated user has powerful computers that interact with the closest concentrator. Theoretically, about 80 users with a 110-bit/s line saturate one concentrator and four or five concentrators saturate a node.

EURONET is a packet-switching network. Each communication message arriving at a node from users or from the data banks is subdivided into packets of the same length (2,000 bits), which are then sent to their destinations individually and do not necessarily follow the same route. Each packet is sent by the route that is most suitable at the moment of forwarding to the successive node.

The final concentrator receives the individual packets and at the destination reconstructs the original message by putting the various pieces of the message back into order and eliminating the parts added for managing the transmission. In practice, at the moment of the breaking-down of the message, each packet is given various codes to accompany it. The packet format contains a piece of the text preceded by the message identification, the packet's serial number, the number of packets, and the addresses of the sending and receiving nodes. The packet is ended by a control word to reveal any transmission errors and, if necessary, ask the preceding node to repeat the transmission of a packet recognized as erroneous.

The packet-switching technique is the most sophisticated and permits better utilization of the transmission channels, especially in integrated networks for servicing audio and video signal transmissions and for machine-to-machine and person-to-person conversations. Other transmission techniques that are in use and are presently more suitable for certain services are the circuit-switching technique and the message-switching technique.

Circuit-switching establishes between caller and called a fixed connection that is not changed in the course of all the messages of one conversation and uses the branches that are free at the moment of the call. The route can be a different one only for a new conversation.

Message-switching, though, selects the most suitable route for each message of a conversation. This route is switched off at the end of a message and may be changed at the beginning of a new message of the same conversation. In some applications, the individual messages are broken down into blocks. These blocks, however, are forwarded one after the other on the same route.

11267
CSO: 3102

TRANSPORTATION

COMMUTER AIRCRAFT BOOM DISCUSSED

Bern TECHNISCHE RUNDSCHAU in German 6 May 80 pp 17, 19

[Article by Sam Iselin: "Commuter Aircraft. Enormous Demand and Extensive Supply in Small Passenger Aircraft"]

> [Text] Recently more and more people have been using the airplane on regional routes. For the commuter lines this is causing a strong increase in the number of passengers and pressure for (occasionally overhasty) expansion. For their part, the airplane manufacturers are countering with an extensive offering of turboprop (PTL) small passenger aircraft of all sizes and capabilities, but yet the vast majority can now scarcely keep up with the orders since production capacity for airframes and especially for engines is being totally utilized. This article gives an up-to-date overview of development and of models being used in commuter traffic.

The Commuter 'Boom'

The term "commuter (or third-level airlines) is applied to airlines that serve regional routes (100-300 km) on a scheduled basis with small passenger aircraft, thus supplementing the network of the large scheduled airlines in a meaningful manner. Frequently, these "third-level airlines" also function as "feeders" to continental airports, either independently or as direct partners of the participating scheduled airlines. Operating a commuter service has become a lucrative business in many places, especially in the United States, where the "Deregulation Act," in effect since October 1979, permits airlines to transfer unprofitable regional routes to the commuters. Thus, the latter opportunely came into a large number of new routes and, thanks to higher traffic densities, they were able to increase passenger volume rapidly and were soon forced to look around for more capacity. Aircraft orders soared and the established manufacturers (DHC, Swearingen, Embraer) had to speed up production as quickly as possible. The very long delivery times and the fact that

Commuter regulation by the American civil aviation agency (CAB) [Civil Aeronautics Board] is presently undergoing radical change and is thus laxer resulting in the fact that new versions of airplanes and projects shot up like mushrooms. Some of these projects will no doubt scarcely survive the very strict new regulations. This is completely within the intentions of the CAB: any kind of commuter "wild growth" is to be forestalled by licensing and operating regulations (in respect to equipment and safety), which are in part rather strict.

As far as the airplanes are concerned, the following approximate trends can be established for the next few years:

--clear-cut dominance of the propeller turbine (500-2,000 brake horsepower [WPS]), for the most part involving a strongly reduced, low-noise propeller,

--increasing passenger capacity with appropriate conveniences,

--a trend toward pressurized cabins (= economic cruising altitude) and higher cruising speeds (= better flexibility in respect to use) in aircraft having 30 or more seats.*

Aircraft Types (Figure 1)

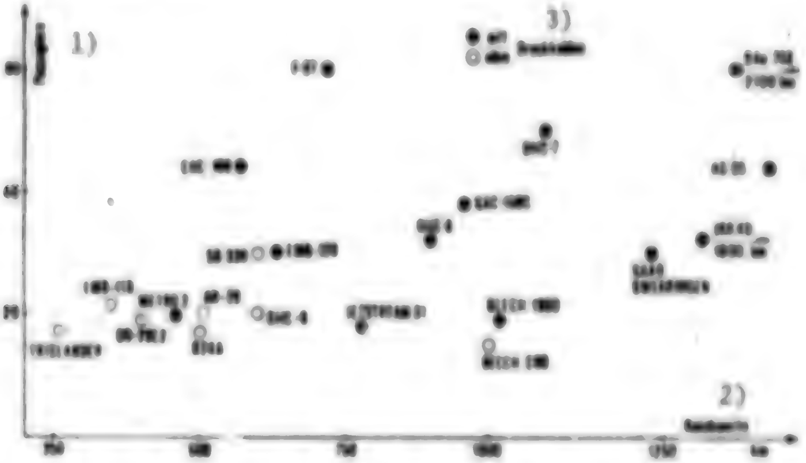


Figure 1. Overview of available commuter aircraft. Number of seats in relation to the range of the plane

Key: 1) Passengers 2) Range 3) with / without pressured cabin

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*World demand for 30-seat commuter aircraft is estimated at about 1,000 planes for the period 1985-1990.

Australia

The light STOL (short take-off and landing) multipurpose airplane N2 Nomad from Government Aircraft Factories (GAF) is available in the utility version N22 and in the commuter design N24A with a longer fuselage and greater weight. So far it has been possible to market approximately 100 of these planes which are especially suited for regional use in developing countries.

Brazil

Embraer is in a position to achieve remarkable success with the EMB-110 Bandeirante: approximately 300 civilian and military multipurpose Bandeirante airplanes have been sold to date. The standard commuter model is the 21-seat EMB 110P2; more than 60 of these have been exported, half of them to the United States. This year production of the P2 is to be increased to 7 aircraft per month, and production for the year will be 70 planes. Embraer would like to continue the Bandeirante success by the pressurized EMB-120 Brasilia. Since the PT7A-engine which is going to be used will not be certified until 1983 the manufacturer still has sufficient time to get the new type ready for series production. Deliveries are to begin in 1984; the company already has five orders.

FRG

Dornier has been engaged for several years with commuter aircraft. Market tests with the LTA (light transport aircraft) project have encouraged the manufacturer to get two new models ready for the market at once: the 15-seat DO-28E1 and the 19-seat DO-28E2. The key component in both versions is the "airfoil of new technology" (TNT) which was developed by Dornier; it is presently being tested on a strongly modified DO-28 (Skyservant), the precursor of the DO-28E1) (Figure 2). The characteristical TNT wing with its characteristic triangular wing tip strip represents one of the [illegible] some of the most modern aerodynamic findings in the commuter sector.

France

Aerospatiale has in progress the AS-35 (most recently also known as ATR, Avion Transport Regional): the 42-seat aircraft has a good range and, it reportedly, is to be built jointly with another company ([illegible] is a possible partner) (Figure 3). Until a decision has been made in this respect, the choice of engine (Turbomeca Makila or PT7A) will no doubt also remain open.

GREAT BRITAIN

British Aerospace (BAe) is advertising the Jetstream 31, a reworked, more efficient version of the HP137 business aircraft of the same name which was

Figure 7. Dornier's flight trials with the "airfoil of new technology" were so successful that the next generation of Dornier airplanes on the commuter market will be so equipped. (Dornier)

Figure 7. Starting in 1983 the French AS-35 will provide feeder services with a cruising speed of 460 km/h. (Aerospatiale)

originally built by Handley Page (who went bankrupt several years ago). The main competitor of the 31 will be the Metro II from Swearingen which is also pressurized. The BAe 748, which will soon be 20 years old (so far about 350 orders), is undergoing a renaissance as a commuter airliner: recently Mountain West in the United States ordered 5 BAe 748 (plus 5 options), and other commuters are likewise evaluating this version. The 4-jet BAe 146 (initial flight in 198) is at present still too big and too expensive for the commuter market. But it is quite possible that in a few years regional traffic volume in some places will justify the acquisition of such 90-seat planes. Shorts, with 58 orders for the SD-330 model, is optimistic in spite of tough advertising pressure: thanks to its spacious fuselage and low maintenance design the rather thickish SD-330 should also continue to have a market in addition to the elegant pressurized (and thus significantly more expensive) competition. A version with stronger PT6A-65 (1,380 WPS) and improved take-off and landing properties is in preparation. In addition, Shorts is working on a 49-seat successor model which is to be put into use starting in 1986.

Italy

Aeritalia is working on the high-wing monoplane project AIT-230 for 30 passengers. Propulsion will be with 2 PT6A-65.

Canada

De Havilland Canada (DHC) with its Twin Otter has created the real "trendsetter" for economic regional aircraft. Today, after over 700 aircraft have been sold, production is going so well that the monthly output must be raised from 4 to 6 planes. The 4-motor Dash-7 (75 orders and options) finishes off the upper capacity range. The extraordinarily quiet airplane is being especially promoted for intercity STOL traffic. The 32-seat Dash-8 was newly announced at the end of 1979. With the same fuselage cross-section as the Dash-7, the aerodynamically polished Dash-8 will complete the palette of the DNC STOL commuters. This model, by the way, might well enter regularly scheduled service as the first member of the new generation of 30-seaters with a pressurized cabin.

Netherlands

Like BAe, Fokker, too, is profiting from the commuter boom: new orders for the F-27 Friendship have been received from regional companies. This year 30 additional F-27 are to be built (to date over 700, including 200 under U.S. license). The 85-seat F-28 Fellowship (159 orders) for the present is feasible only for financially strong commuter customers: yet, Fokker has already received several orders from regional lines.

Sweden

Saab-Scania is jointly developing with the Swearingen Division of Fairchild a 30-seat PTL model with pressurized cabin. Engine manufacturer Volvo-Flygmotor will, for its part, be involved in the development of the plane's engine (Garrett TPE331-14).

Switzerland

Since taking over the Britten-Norman, Pilatus-Britten-Norman also has a mini-airliner in its program, namely the tri-motor Trislander. The plane, which is very easy to maintain, is well suited for regional traffic in developing countries.

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INTEREST IN COMMUTER AIRCRAFT GROWING

Rome AVIAZIONE in Italian Feb 80 p 48

[Excerpt] Aeritalia recently announced it will enter the small-to-medium capacity transport aircraft market and has decided to produce an aircraft whose payload is not, as of yet, precisely defined, except that it should be able to fly with 40 to 50 passengers. In case of positive answer with regard to the financing of the expense for applied research, the project should be ready in 1982, with deliveries expected in 1985. Partenavia has an aircraft on the design board aiming toward low density trips and able to carry 16 to 19 passengers calling for a low purchase price and maintenance expense. Plans envision a price tag of 30 million lire per passenger seat. This twin engine aircraft will be powered by a very new turboengine: the Alfa Romeo-Rolls Royce RB 318, which is the ideal motor for this type of flying, having been designed with simplicity, efficiency and economy in mind. If given the go ahead, this aircraft should be certifiable by the end of 1982. Other Italian aircraft which could be used as commuter aircraft include the new Generalavia twin engine F-600 Canguro, with 10 seats (and for which SIAI-Marchetti is maneuvering for an eventual series production contract) and the Piaggio P-166 DL3, also a 10 seater, with Lycoming LTP 101 587 horsepower turbine engines.

As can be seen, the competitors wanting a slice of the commuter aircraft market are many and are aggressive. The winners will be those who will know how to orchestrate and promote the principal ingredients, which include price, capability, flexibility and operational cost, post-sale assistance as well as financial planning to be offered to clients with the aid that all governments of industrialized powers earmark for export. Our air industry, even though late on the scene, still has some opportunities in this field, one which appears well disposed toward offering financial and technical opportunities. So the air transport industry too has modest reserves that can be used in a third level sector, contributing to the economic uplift of vast areas as well as creating a well qualified working force.

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CSO: 3102

TRANSPORTATION

FIAT'S 'ACE-IN-THE-HOLE' ENGINE DESCRIBED

Milan L'UNITA in Italian 19 May 80 p 7

[Article: "FIAT's 'Ace-In-The-Hole' Is Called Volumetric Compressor"]

[Text] FIAT has requested the layoff of 78,000 of its personnel, officially to reduce inventory overstocks. This proposal however, does not concern workers engaged in the construction of small cars, the demand for which continues to be felt and in some cases (read "Panda") calls for rather lengthy waiting periods.

The problem therefore deals with the sector involving cars having medium to medium-large engines whose costs (beyond initial purchase price) are higher, most of all because of the ever rising price of gasoline. It is possible, perhaps simplistically, to draw a conclusion: if cars with medium-large engines do not sell because they use too much gas, all that would be needed would be to find a method to reduce gas consumption and the problem would be solved.

It is well known that all auto manufacturers are studying ways to construct cars that use less gas. In order to achieve this goal, Ford (as we previously mentioned in this column) has designed an engine of this kind incurring the expense of 800 billion lire: Volkswagen, for its part, is advertising its "Formula E" product, the car of the future, defined as "the intelligent car for the intelligent driver" which, to achieve a 10-precent gas reduction, calls for a whole series of expensive mechanisms, to include a "stop-start" mode, which allows engines to stop while waiting at red lights and to pick up again without making use of the starter.

We could go on and on listing these items, but we want to single out one in particular: FIAT already possesses a mechanism which allows engines between 1.3 and 2.0 liters a savings of 20 percent on the test bench and 10 percent on the road while simultaneously cutting down on harmful exhausts: and yet, it is not used. Why?

The question has remained unanswered except for a vague reference to the need to continue testing. Yet FIAT has achieved concrete results at the

Mandria test track based on a 2-year research program done by Abarth under the direction of engineer Aurelio Lampredi. The end-result is a "compressor volumetrico" which is conceptually different from the turbocompressor engine activated by exhaust gases, namely one which among others improves energy output for high-performance engines but does not reduce gas consumption. Thus in this latter type of engine the mechanism is particularly useful in competitions where the most relevant factor is energy output generated by high performance motors.

The "compressore volumetrico," on the other hand, directs a given air volume to the cylinders in proportion to its rotation cycle, the air being directly channeled by the motor. At any rotation speed, the rapport between the amount of air inducted by the compressor and the volume of air taken in by the engine remains practically constant. (Engineer Lampredi wished to remind us that this is not a new technical discovery and that in fact in 1927 a FIAT with a "compressore volumetrico" won the Monza Grand Prix.)

Furthermore, and at this point FIAT-Abarth technicians will take over the explanation, a theoretically constant pressure hypersupply is achieved: the engine, whether rotating at a minimum or at a high rate, is supplied with a hyper input having the same amount of pressure. Consequently, even at a low rate of rotation, a high increase in deflecting torque is achieved: its maximum increase can even reach up to 30-40 percent at an overpressure rate of only 0.4 to 0.5 bar. The response to acceleration is immediate. Maximum power increases by 20 to 30 percent, allowing for significant acceleration and pickup in addition to an increase in maximum speed.

In the experimental phase, which lasted 2 years, 2 routes were chosen. In the first, a low pressure "compressore volumetrico" was used, with carburetor, on the twin driveshaft 2.0 liter engine on a 131 Racing. This resulted in an increase of maximum power by 27 percent (as though one were dealing with a 3.0 liter engine) and an increase in torque by 39 percent. This enables the possibility of significantly increasing performance, while maintaining, at a constant speed, gas consumption equal to that planned for the full scale production vehicle, namely up to the speed of 180 kilometers per hour.

The 131 Racing, when thus modified, without changes to the gear box or axle, sprints 1.4 seconds faster than the series production model over a course of 400 meters from a dead start; 2.5 seconds faster over 1,000 meter track; and 4.4 seconds over a 2,000 meter track. Results are even more startling when from a speed of 40 kilometers per hour and the fifth gear was engaged: calculating with distances of 400, 1,000 and 2,000 meters, the timing differences increased to 2.5, 4.8 and 7.5 seconds respectively.

For the second research route, as FIAT-Abarth reminds us, work began using a 1.3 liter twin drive shaft engine taken from a 131 Supermirafiori using the same hyper intake mechanism, with the goal of attaining the same power ratio as the 2.0 liter induction engine. This goal was reached, with the result that the vehicle tested had the same characteristics of the 131 Racing 2.0 liter inducted engine but with greatly reduced gas consumption.

Up to this point, Abarth technicians have been providing data. The Mandria test trials have confirmed the pleasure in driving and speed flexibility of the 131 with the "compressore volumetrico." The size and weight of the mechanism do not present any installation problems on series production vehicles. (If necessary, in addition to the 131s, a way could be found to put a compressor also on the Ritmo.) The cost is comparable to the expenditure for an electronic starting system. The compressor could be built "in-house," and there are no upkeep problems. In short, FIAT has "an-ace-under-the-hood"; why doesn't FIAT market it?

9209
CSO: 3102

TRANSPORTATION

UNIQUE FLYWHEEL-DRIVEN BUS DESCRIBED

Helsinki HUFVUDSTADSBLADET in Swedish 29 May 80 p 20

[Text] The new sensational Swedish bus drives in and out of bus stops, or for kilometers through sensitive city areas, as innocent and harmless to the environment as a wound-up toy car. Actually, Volvo's innovation operates in these situations just like many toys, driven only by a flywheel with the diesel motor shut off.

But the saving of energy is not a light matter--it involves 3500-6000 liters of fuel per bus each year. It is no child's play what remains to be done before the bus is in regular city traffic, by 1985. What we have before us are only prototypes.

People in many countries, not least the Federal Republic of Germany, Japan and the USA, are working on the pertinent task of reducing the consumption of fuel by saving the energy which is wasted by the constant braking of city buses at stops and in traffic.

"The problem has been seriously studied at Volvo since 1975. Different techniques for the storage of energy and the transmission of power have been tested and rejected," says Rolf Soderhielm, chief of Volvo Bus AB.

For example, the storage of energy in hydraulic pressure batteries requires heavy equipment and extensive safety configurations and do not give the same possibility for energy output with a fully constant effect as does the flywheel principle.

Also the battery alternative makes the bus too heavy and it is not suitable for quick storage as required by city traffic.

Unique Solution

Consequently, the flywheel has been decided upon, and the unique technique of such a device in combination with hydrostatic transmission has been developed cooperatively by Volvo Bus AB and Volvo AeroMotors AB. The last named company has had much experience in its work with the Viggen jet engine, with a hydrostatic driving force and a rapidly rotating mass.

As far as is known, competitors, among others the Germans, have made some progress with the flywheel technique, but they have not reached the stage of showing the press functioning flywheel busses. The Swedes are in the lead and have come the farthest.

The first prototype was completed in 1976 and was ready for technical tests in the summer of 1977. After satisfactory technical results--the bus went through technical functional tests--Volvo built a new prototype bus. It was ready in April 1980 and will be driven in extensive trials in Volvo's testing grounds under various simulated driving conditions of an urban environment.

After a few years a small number of vehicles can be tested during normal bus-driving in cities. Volvo now desires the customers' reaction to the new technology before they decide to go on with the project. One hundred million kroner will have been invested before they are ready for industrial production.

Weaker Diesel Motors

The new bus will store energy for braking in a flywheel which will be placed in close proximity to a smaller diesel motor. The motor now being used will develop 140 horsepower compared to almost 230 hp in an ordinary city bus. In braking, energy will be returned to the flywheel, which will then help with the next acceleration. The transmission of power to the driving-wheel is made with the help of hydraulic machines from Volvo AeroMotor. Volvo calculates in this manner to save 15-25 percent of diesel fuel, depending on driving conditions, in an ordinary city bus (about 3500-6000 liters per bus each year).

Advantages to the Environment

Moreover, the bus can be driven exhaust-free and very quietly for about 1200 meters in normal city traffic without any diminution in performance. During this time the diesel motor is shut off, and the bus is driven only by the flywheel. It is also possible in other stretches automatically to shut off the motor before the stop and later to start the diesel motor after the bus has left the stop. That is environmentally advantageous for the passengers and people living near the bus stops.

Hydraulics together with the flywheel thus replaces the present conventional gearbox. One utilizes energy better and gets a completely jerk-free acceleration and braking.

The prototype busses have also a conventional brake system, but it is used only in emergencies. Normally, the bus is braked only by the flywheel. The vehicle is maneuvered with only one pedal for gas, flywheel brakes and emergency brakes.

Even, Soft

This technical news bombshell gathered almost as many journalists in Goteborg as the world championship in skating a few years ago. On Wednesday the Nordic press, including some 20 Finns, could test ride the prototype busses. On Thursday it is the turn of the other European journalists.

The experience of the tour in the busses which are equipped with extensive electronic control and measuring instruments was quite pleasant. The acceleration is, despite its rapidity--down to 10 seconds from 0 to 50 km per hour--quite even and smooth. There are never any of the jerks which a conventional gearbox offers. And that means both comfort and safety. The same goes for braking.

With this new system busses actually should not only produce cleaner air, but also be quieter than normal busses. That could not be directly established since the noise insulation details have been postponed in the hurried task of producing prototypes which demonstrate that the flywheel and transmission system works.

Also Long "Clean" Stretches

The bus has a top speed of 80 km an hour, which is sufficient for driving in city and suburban traffic under most conditions. With continued technical development the top speed will be increased to 90 km so it will be adequate for all bus lines.

The bus can, as has been pointed out, go almost 1.2 kilometers on the energy solely from the flywheel without any diminution in performance, whereupon the dieselmotor quickly charges up the flywheel again. Volvo believes that there are good prospects for increasing the possibility of the bus being driven exhaust-free and completely quiet for even longer distances, but continued technical development will have to show that.

It is a question of specific goals. 1.2 km (a flywheel which weighs 333 kg. has that potential) was selected because it corresponds to the normal distance between four city stops.

Also On Trains

It is apparent that the technique is also very well suited to suburban trains, metro, etc. At the moment Rolf Soderhielm does not want to comment on other applications.

It is hardly feasible to add on the heavy energy apparatus to passenger cars which sometimes are driven in city traffic and sometimes on the highways. Possibly for pickup cars and such.

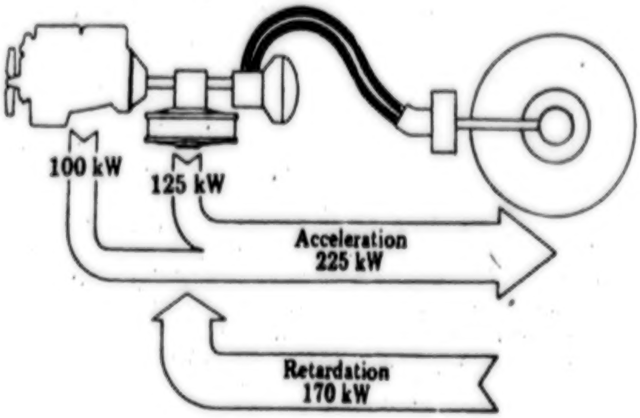
"Now it will be the market which will let us know if it pays to go into production," Soderhielm says. "We could be ready in 1985 or 1986. There remain in any case tests which take time."

Will the flywheel technique be more expensive even if a radically weaker alternative motor is being proposed?

"Yes. It will be more expensive. But not necessarily heavier."

But nevertheless the technique is economically interesting.

"Based on the current price of fuel the increased investment cost will be repaid during the life of the bus in fuel savings. And energy hardly will become cheaper," Soderhielm maintains.



Schematic diagram of the interconnection of the various components. The primary engine, far left, operates at between 1600 and 2000 revolutions. The flywheel, to its right, rotates at 10,000 rpm when it is supplied with braking energy. A hydraulic transmission transfers 225 kW to the wheel. During braking, 170 kW is returned to the flywheel.

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